*Faculty of Education* *Sohag University*

*Journal of Education*

# *Applied College Students' Use of Algebraic Thinking Skills in Solving Financial Mathematics Problems: An Emerging Model*

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**Receipt date: 20 March 2025 - Date of acceptance: 9 May 2025**

***ABSTRACT***

Algebraic thinking skills are essential in professional life, particularly in financial fields that require precise planning, interest calculation, and investment decision-making. This study aimed to analyze how students enrolled in the Banking and Finance Diploma program at the Applied College of Umm Al-Qura University employ algebraic thinking skills when solving simple interest problems in the Financial Mathematics course. A qualitative approach grounded in the principles of grounded Theory was adopted, with a purposive sample of twenty students who had completed the course. Data were collected through semi-structured interviews based on realistic, contextualized mathematical tasks. The findings revealed an emerging theoretical model comprising four interrelated cognitive processes that characterize students' algebraic thinking. These processes are: (1) understanding the problem through repeated reading and identification of known and unknown elements; (2) implementing the solution by interpreting symbolic meaning, using abstract representations, applying algebraic properties, and employing functional thinking to analyze variable relationships; (3) evaluating the solution through verification, simplification, and symbolic manipulation; and (4) expanding the solution by generalizing the structure of the simple interest formula and applying it to broader contexts. The model also underscores the influence of several intervening factors on students' algebraic reasoning, including their abilities, prior knowledge, instructional methods, motivation, and attitudes toward mathematics.

***Keywords:*** algebraic thinking skills, grounded Theory, simple interest problems, emerging theoretical model

# استخدام طلاب الكلية التطبيقية لمهارات التفكير الجبري في حل مسائل الرياضيات المالية: نموذج ناشئ


## المستخلص

تُعد مهارات التفكير الجبري من المهارات الأساسية في الحياة المهنية، لا سيما في المجالات المالية التي تتطلب تخطيطًا دقيقًا، وحسابًا للفوائد، واتخاذ قرارات استثمارية. هدفت هذه الدراسة إلى تحليل كيفية توظيف طلاب دبلوم البنوك والتمويل في الكلية التطبيقية بجامعة أم القرى لمهارات التفكير الجبري أثناء حل مسائل الفائدة البسيطة ضمن مقرر الرياضيات المالية. اعتمدت الدراسة على المنهج النوعي باستخدام النظرية المجذرة، وتم اختيار عينة قصدية مكونة من عشرين طالبًا ممن أنهوا دراسة مقرر الرياضيات المالية. أُستخدمت المقابلات شبه المنظمة القائمة على مهام رياضية سياقية واقعية لجمع البيانات. وكشفت نتائج التحليل عن نموذج نظري ناشئ يتضمن أربع عمليات معرفية رئيسية توضح آليات استخدام مهارات التفكير الجبري لدى الطلاب، وتشمل (١) فهم المشكلة من خلال القراءة المتكررة واستخراج المعلومات المعروفة وغير المعروفة، (٢) وتنفيذ الحل من خلال تفسير الرموز واستخدامها بشكل تجريدي وتطبيق الخصائص الجبرية، بالإضافة إلى توظيف التفكير الوظيفي لفهم العلاقات بين المتغيرات. (٣) كما تشمل تقييم الحل من خلال التحقق من النتائج وتبسيطها، (٤) وتوسيع الحل عبر تعميم النمط الرياضي لصيغة الفائدة البسيطة وتوظيفه في مواقف جديدة. كما أظهرت الدراسة تأثير مجموعة من العوامل المتداخلة على استخدام مهارات التفكير الجبري، أبرزها قدرات الطلاب، ومعرفتهم السابقة، وأساليب التدريس، والدافعية، والاتجاهات نحو الرياضيات.


**الكلمات المفتاحية:** مهارات التفكير الجبري، النظرية المجذرة، مسائل الفائدة البسيطة، النموذج النظري الناشئ

## 1. Introduction

Algebraic thinking is considered essential for enhancing students' academic and professional abilities. Studies indicate that algebraic thinking strengthens logical reasoning and problem-solving skills (Yang & Deng, 2024). Additionally, it is crucial for understanding complex concepts, as it enables students to make generalizations and abstractions while solving mathematical problems(Jahudin & Siew, 2024). On the other hand, algebraic thinking is viewed as a measure of job readiness in higher education, as many careers, especially in finance, require algebraic thinking (Pratama & Masduki, 2024). As research in algebra teaching and learning deepens, studies have regarded algebraic thinking skills as the central focus of algebra education research (Sibgatullin et al., 2022).

With the continued expansion of research in teaching and learning algebra, algebraic thinking skills have emerged as a distinct field of study in the past two decades. Initial investigations focused on identifying the pathways of algebraic thinking skills among elementary school students. Many researchers have suggested looking at algebraic thinking skills from different perspectives and with varying degrees of importance. For example, (Lew, 2004). focused on six algebraic activities students should engage in: generalization, abstraction, analytical thinking, dynamic thinking, and modeling. (Kieran, 2004) mentions three components of algebraic thinking: the ability to generalize, the ability to transform, and the ability to think at a higher global level.

Meanwhile, Kriegler (2008) organized algebraic thinking into mathematical thinking tools and fundamental algebraic ideas. Mathematical thinking tools include problem-solving, representation, and quantitative thinking skills. Fundamental algebraic ideas include algebra as generalized arithmetic, algebra as the language of mathematics, and algebra as a tool for functions and mathematical modeling. Despite the diversity of these skills, specific skills have remained prevalent in the literature on algebraic thinking, highlighting their significant role in student engagement.

Generalization is considered one of the most essential algebraic thinking skills emphasized in the literature of algebraic thinking. (Lew, 2004)defines it as finding a pattern or model. (Harel& Tall1991)Describe it as applying concepts or procedures in a broader context. This process can be observed in activities such as identifying patterns and relationships in a sequence of numbers, solving problems using the patterns discovered, or solving problems using a simplification strategy (Sukmawati et al.,2018). Therefore, this skill is crucial in helping students understand what lies beyond the specific case and transition to broader stages.

Despite the importance of this skill, students face significant challenges when working with it. Results (Maula et al.,2024)have shown that students encounter obstacles and difficulties in the generalization process, particularly in the expressive and symbolic stages. Furthermore, Andini& Suryadi (2017) add that a lack of familiarity with identifying fundamental rules is one of the reasons for generalization difficulties, as students are not accustomed to recognizing and applying general patterns, which hinders their ability to solve algebraic problems effectively. Although students may grasp new concepts within their current frameworks, they often face challenges when required to absorb and reconstruct their understanding of more complex mathematical scenarios (Dorko,2019).

Abstraction is considered one of the essential algebraic thinking skills highlighted in the literature. Abstraction deals with symbols(Lew, 2004). It is the use of symbols to extract mathematical concepts and relationships. It requires an understanding of the meaning of the symbol and the representation of information using symbols by separating these symbols from their context and working with them as relationships. As Pratama and Masduki (2024) noted, an additional indicator of abstraction is the ability to explain the steps involved.

Analytical thinking is essential to algebraic thinking skills (Lew, 2004). It involves the silent reading of the problem, breaking it down, and the cognitive processes related to the operations used to find unknown values (Rahmawati et al.,2019).

Functional thinking is an essential aspect of algebraic thinking skills. Functional thinking is crucial in higher education for solving complex mathematical problems, such as function formation, where students must generalize relationships between quantities(Najma& Masduki, 2023). (Nusantara et al.,2022)It is the understanding of how one thing changes when another changes. This type of thinking allows for recognizing the relationship between two variables. Students demonstrate it by understanding how changes in one variable affect another, leading to generalizations about these relationships. In other words, it focuses on the relationships between variables and generalizes these relationships (Martins et al.,2023).

Algebraic thinking skills do not operate in isolation. Previous literature has attempted to describe them through problem-solving steps, such as studies(Nurhayati et al.,2017; Rahmawati et al.,2019; Sukmawati et al.,2018). Despite their importance, research that attempts to understand algebraic thinking skills through contextual problems related to students' future professions is scarce. Contextual problems provide a fertile environment for understanding students' abilities. They serve as tasks to link mathematical theories with real-life situations, thereby increasing students' functional understanding. Empirical studies have demonstrated the success of these tasks in helping students transfer abstract mathematical theories to practical examples(Clarke& Roche,2018). These problems assist students in understanding how to apply mathematical concepts and skills to solve real-world issues, such as financial calculations and measurements. Students develop problem-solving skills, logical thinking, and communication abilities by engaging in contextual tasks, ultimately enhancing their mathematical literacy and increasing their motivation and interest in studying mathematics(Akperov& Yessenkeldy, 2023). Research highlights that using topics relevant to students in context enhances the investigative approach, improves understanding of problem data, and uncovers essential mathematical relationships. This method not only aids in problem-solving but also supports conceptual learning of mathematical content, making the learning experience more relevant and effective for students(Fernandes Souto& Guérios, 2022). Contextual problems are essential for promoting algebraic thinking, requiring students to interpret and express mathematical concepts in real-life situations(Laswadi, 2023). Contextual problems help strengthen algebraic thinking by linking abstract algebraic concepts to real-life situations, making them more comprehensible for students. The study indicates that students with strong algebraic thinking skills are better at solving contextual mathematical problems. Misconceptions often arise when students struggle to translate contextual scenarios into algebraic expressions, mainly due to difficulties understanding variables and operations. Therefore, effective teaching strategies incorporating contextual problems are crucial for improving students' algebraic understanding and problem-solving abilities (Saaroh et al.,2021).

Despite the importance of algebraic thinking skills, they are insufficient for students to achieve advanced algebraic knowledge (Schommer, 1990). Many influencing factors depend on more than just algebraic content knowledge. For instance, prior understanding or misconceptions can hinder the acquisition of new knowledge when the latest learning content is incompatible with previous learning. This often leads to mistakes that prevent algebraic understanding (Windsor & Norton, 2011). Furthermore, learners' learning styles impact their success in algebraic thinking (Kobandaha et al.,2019), and mathematical ability levels influence the development of algebraic thinking skills (Rahmawati et al.,2019). Psychological factors, such as perseverance and motivation to engage in learning processes, also play a role in student success, including trial-and-error motivation and persistence in solving problems (Rahman et al.,2012). Moreover, the context of mathematical problems and their relevance to students' future professions also has an impact. Results from a study by Lovett & Greenhouse (2000) indicated that students' attitudes toward learning improve when the content is linked to their future careers. Therefore, algebraic thinking occurs within problem-solving contexts and is closely related to them (Rahmawati,2018). This helps students develop their algebraic thinking and provides a more profound career-oriented learning pathway.

Previous studies have focused on describing algebraic thinking skills in solving mathematical problems. For instance, Study (Nurhayati et al.,2017) aimed to assess the algebraic thinking abilities of high school students in algebra as generalized arithmetic, algebra as a mathematical language, and algebra as a tool for modeling and functions in pattern problems. Meanwhile, a Study (Rahmawati et al.,2019) aimed to describe and explain high school students' algebraic thinking skills in the context of problem-solving, relying on three levels of ability: high, medium, and low. This study utilized Lew's framework for algebraic thinking skills and the problem-solving framework by Herbert and Rebecca Brown. The study (Sukmawati et al.,2018) focused on describing the algebraic thinking profile of elementary school students in solving verbal problems based on cognitive styles of independence/dependence. The study (Rusyid et al.,2024) aimed to describe the algebraic thinking abilities of high school students based on their capabilities, with a particular focus on linear equations. The study (Pratama & Masduki, 2024) aimed to investigate algebraic thinking skills in students, mainly focusing on the components of generalization and abstraction about their cognitive styles. Previous research has concentrated on understanding algebraic thinking skills among general education students, leaving a gap in understanding them in university settings. While qualitative descriptive methods have been widely used, this has created a gap in the application of grounded theory methodology.

## 2. Study Problem

Despite broad consensus in the educational literature regarding the significance of algebraic thinking in strengthening mathematical competence and linking theoretical understanding with practical application, a noticeable gap remains—particularly in applied programs like the Diploma in Banking and Finance—between abstract algebraic concepts and real-world financial tasks (Sibgatullin et al., 2022; Fernandes Souto & Guérios, 2022). Semi-structured interviews and task analyses revealed that students struggle with symbolic representation, variable identification, and mapping contextual language to mathematical forms, indicating limited abstraction skills (Lew, 2004; Pratama & Masduki, 2024).

Rahmawati et al. (2019) found that students with low-to-average problem-solving ability often rely on numerical computation rather than symbolic manipulation, limiting their ability to generalize patterns or verify results. Studies by Sukmawati et al. (2018) and Dorko (2019) further emphasized that generalization difficulties stem from understanding how specific cases relate to broader algebraic structures, one of the core pillars of algebraic thinking.

Additionally, Lovett & Greenhouse (2000) emphasized that connecting mathematics with students' future professional contexts, such as banking, significantly improves engagement and performance. Akperov & Yessenkeldy (2023) reinforced the value of contextual tasks in fostering functional understanding and real-world mathematical application among students.

Given this background, the present study aims to explore how applied college students use algebraic thinking when solving financial problems and to analyze their cognitive strategies through Grounded Theory, thereby constructing a model that reflects actual classroom experiences.

### 2.1. Study Objectives

- Analyzing how Banking and Finance Diploma students use algebraic reasoning skills to solve simple interest problems in a financial mathematics course.

- Constructing an emerging theoretical model that describes the cognitive processes students undergo when using algebraic reasoning skills.

- Exploring the intervening factors (cognitive and non-cognitive) influencing students' ability to employ algebraic reasoning skills in realistic financial contexts.

- Providing a scientific framework that can be used to develop curricula and teaching strategies in financial mathematics courses in applied education.

### 2.2. Study Questions

Research Question: How do Banking and Finance Diploma students at the Applied College use algebraic thinking skills in solving simple interest problems?

### 2.3. Importance of the study

This study derives its significance from addressing an underexplored group—applied diploma students—and its effort to understand how algebraic thinking skills are enacted in solving realistic financial problems. It contributes to developing an emerging theoretical model that captures students' actual practices and highlights the cognitive and affective factors influencing their performance. The findings offer a research-based foundation to enhance the design of financial mathematics curricula and promote context-driven, workforce-relevant teaching practices.

## 3. Materials and Methods

### 3.1. Study Method

This study utilized the Grounded Theory methodology established by Glaser and Strauss (1967) as an alternative to traditional qualitative research methods. This methodology is based on the inductive principle of generating a theory by systematically analyzing the data collected. Grounded Theory relies on the principle of simultaneous data collection and analysis, and it is preferable to begin the process with a small amount of data to analyze rather than collecting large amounts of data all at once. Since its inception in 1967, Grounded Theory has evolved into different strands. The approach chosen for this study is the one developed (Corbin& Strauss, 2008). The coding process consists of three stages: open coding, axial coding, and selective coding, with the creation of data analysis tools such as the coding paradigm and the conditional matrix.

Other analysis techniques, such as memo writing and theoretical sampling, are employed, leading to theoretical saturation.

### 3.2. *Participants*

Purposeful sampling was used to select the participants to ensure the inclusion of individuals with characteristics relevant to the study's objectives. Twenty newly enrolled undergraduate students from the Diploma in Banking and Finance program for 2022–2023 were selected. The selection criterion was that the student had completed the Financial Mathematics course. All participants were male and enrolled at the fourth level.

### 3.3. Study Instrument

Task-based interviews were used in this study due to their suitability for the research purpose. One of the advantages of this type of interview is that it encourages students to explore their skills and personal strategies (Goldin,2012). In this study, task-based interviews were conducted in an unstructured format, as they offer more flexibility than structured interviews and allow for variation in the context of questions related to the tasks (Leton,2022). A single problem related to simple interest was presented, and students were encouraged to solve it, think aloud, and justify their reasoning. The interviews proceeded alongside their mathematical solutions during the students' problem-solving process. Algebraic thinking skills and other behaviors exhibited by students during the solution process and their responses to interview questions were tracked. The validity of the questions was verified by presenting them to two mathematics education experts and two individuals who had previously taught the course, and there was a good agreement on the credibility of the questions.

| |
|---|
| A person deposited 500,000 Riyals in a bank offering a 6% interest rate for 5 years. How will the simple interest change if the period is increased to 7 years? |

Figure 1. A sample question on simple interest

The data was analyzed concurrently with data collection through three stages of constant comparison: open, axial, and selective coding. The study results detail the coding and analysis techniques.

### 3.4. Data Collection Procedures

- Individual interviews were conducted quietly and lasted approximately 30–45 minutes. With participants' consent, all sessions were audio recorded.
- Students were asked to solve contextual tasks in writing or through think-aloud protocols.
- Responses were transcribed verbatim and organized for coding and analysis.

### 3.5. Reliability

According to Lincoln and Guba (1985), the reliability of qualitative studies depends on the researcher's ability to convince readers that the findings are worth reading. These criteria were adhered to throughout the study as they align with the principles of qualitative research (Table 1).

Table 1. *Reliability of the study*

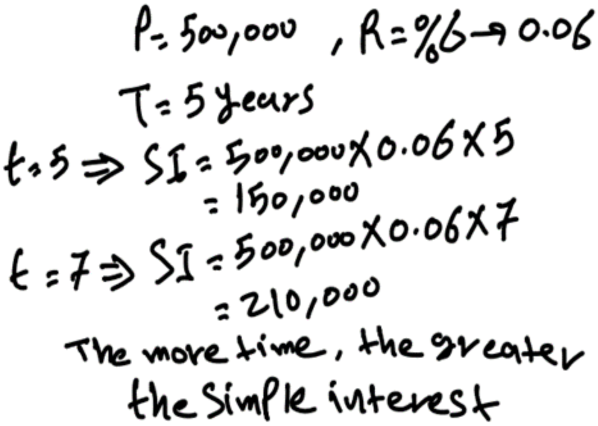
| Strategies used | Credibility | Dependability | Conformability | Transferability |
|---|---|---|---|---|
| Using notes | √ | √ | | |
| Lengthy association with data | √ | √ | | |
| Coding emerging categories by qualitative experts and arriving at a consensus | √ | √ | | |
| Validating of results and quality assessment by two mathematics specialists and a faculty member who previously taught the course | | | | √ |

# 4. Results and Discussion

The results are presented in two sections. The first section represents the prototype, which is the case of a single student. It describes the algebraic thinking skills needed to solve simple interest problems. It explains how the results were obtained through the three stages of analysis: open coding, axial coding, and selective coding. In the second section, all remaining student cases are presented according to the previous three stages of analysis, culminating in the final emerging model.

## 4.1. The preliminary framework of algebraic thinking skills in solving simple interest problems for a single student

This section presents the student's solution to the question and excerpts from the interview. Subsequently, excerpts from the open, axial, and selective coding processes are provided. The preliminary framework is then presented in narrative form.




**A sample of the student's solution**

Figure 2. A sample of the student's solution.

**Interview with the Student**

**Interviewer**: What was the first thing you thought about when you read the question?
**Student**: I read it more than once to understand it… There is a principal amount, an interest rate, and two time periods.
*(Internal analysis: The student demonstrates basic analytical thinking by reading repeatedly and distinguishing known from unknown.)*
**Interviewer**: How did you start solving it?
**Student**: I used the simple interest formula… I think it is I = P × R × T.
**Interviewer**: Yes, that is correct. What did you do next?

**Student**: I substituted directly:
500,000 × 0.06 × 5 = 150,000
Then I did it for 7 years:
500,000 × 0.06 × 7 = 210,000
*(Internal analysis: The student correctly used symbolic representation, showing a good level of abstraction.)*
**Interviewer**: What did you notice about the difference?
**Student:** The interest increased as the time increased… about 30,000 per year.
*(Internal analysis: The student demonstrates functional thinking, recognizing a linear relationship between time and interest.)*
**Interviewer:** Can you guess the interest for 10 years without a calculator?
**Student:** I think it is 500,000 × 0.06 × 10 = 300,000… It is easy because I saw the pattern.
*(Internal analysis: The student applies generalization by extending the pattern to a new case.)*
**Interviewer:** Do you prefer these kinds of realistic problems or more abstract ones?
**Student:** I prefer problems with real-life numbers, like banking. It feels more meaningful.
*(Internal analysis: The context boosts students' motivation and helps deepen their symbolic understanding.)*

### 4.1.1 Open Coding

The first phase began with open coding line by line to analyze the first student's responses to simple interest problems and semi-structured interviews. Each line in the data was labeled with abstract concepts reflecting algebraic thinking skills and the surrounding factors influencing the student's solution. The open coding process was driven by generative questions and comparisons, guiding the researcher to identify concepts related to algebraic thinking and use them for continuous questioning and comparison. This enabled the researcher to reduce subjectivity and bias (Corbin& Strauss, 1990). To guide the open coding process, the questions defined by Charmaz were utilized in this phase, such as "What is the data of the study?", "What does the data tell us?" "What do the data represent or reflect?" and "What could they collectively represent?" (Charmaz& Thornberg, 2021). Table 2 illustrates a sample of the open coding for the student's solution and the interview transcript.

**Table 2.**
**Excerpts from the open coding of the student's solution and the interview transcript.**

| Incidents (Text) | Category / Dimensions |
|---|---|
| **Read the problem and understand its context** | **Making meaning<br>Reading the problem<br>Understanding the problem** |
| **Identify the known and unknown information.** | **Analytical thinking / Differentiation** |
| **Use the symbols SI, R, T, and P.** | **Abstracting /the meaning of the symbols / Using the symbols.** |
| **Find the interest when the time = 5, and also when the time = 7** | **Functional thinking / The relationship between the variables.** |
| **Yes, sir (when asked about the general pattern of the simple interest formula)** | **Generalization** |

### 4.1.2 Axial Coding

The characteristic attributes were written in this phase, and relationships between categories and subcategories were inferred. This was done using questions such as what, when, where, why, how, and what is the outcome (Corbin& Strauss, 2008). These questions aim to understand the relationships between categories and to extract the main category/categories. The approach used by Scott was also applied, placing it into a relational matrix (Scott& Howell,2008). The relational matrix helps uncover relationships between categories when combined with generative questions. Table 3 illustrates excerpts from the axial coding using the relational matrix.

**Table 3**
**. Excerpts from the axial coding using the relational matrix.**

| Category | When | How | Consequences |
|---|---|---|---|
| **Analysis** | **When interacting with the question** | • **Read the problem multiple times.**<br>• **Identify the given data and the requirements**<br>• **Organize the solution process** | **Understanding the problem** |
| **Abstraction** | **When interacting with the question** | • **Meaning of the symbols**<br>• **Use of the symbols** | **Implementing the solution** |

### 4.1.3 Theory Determination through Selective Coding and Sorting Categories

Selective coding is the process through which all categories are unified around a "core" category, and categories that require further clarification are filled with descriptive details. This coding is associated with theoretical saturation, as some categories may be weak while writing and formulating the Theory, requiring additional theoretical sampling to study their significance within the context. This is because grounded Theory focuses on the density of concepts. In this phase, the Theory was written and presented in a narrative form based on the first student's case.

Algebraic Thinking Skills in Solving Simple Interest Problems. In the first case, the process involves a cycle of understanding the problem, solution strategies, verification, and generalization. To understand the problem, the student typically engages in analytical thinking, which is done by reading the problem multiple times and attempting to extract and organize the information. Then, the student moves on to implement the solution through abstraction, demonstrated by understanding the meaning of the symbols and using abstract symbols that describe the given data and the unknown in the problem. Afterward, the student returns to analytical thinking by attempting to apply algebraic properties to reach the solution. The student then begins to consider the relationship between variables through functional thinking to understand the relationship between the time variables in the problem. Following this, the student reaches the crucial stage of generalization by applying the general pattern of the problem to other problems. This indicates that the student uses algebraic thinking skills (analytical thinking, abstraction, functional thinking, and generalization) while solving simple interest problems. This description aligns with the studies (Rahmawati et al.,2019; Sukmawati et al.,2018), which showed that high-ability students can efficiently demonstrate algebraic thinking skills. When interviewed, the student expressed certain beliefs about solving simple interest problems in mathematics that influenced their behavior when faced with such tasks. They believe they can solve the problem correctly when they can derive/recall the formulas after carefully analyzing them and performing the necessary operations.

### 4.2. The Final Model of Algebraic Thinking Skills in Solving Simple Interest Problems

The final model is presented after the open coding, axial coding, and selective coding processes are repeated with the remaining students.

Figure 3 illustrates the emerging integrative framework of core categories for using algebraic thinking skills in solving simple interest problems among students of the Banking and Finance diploma program. The central construct that emerged from the investigation is students' use of algebraic thinking skills in simple interest problems. Four main processes were identified as part of an emerging substantive theory regarding students' use of algebraic thinking skills. These differentiated and related processes are: 1) Understanding the problem through repeated reading, extracting the known and unknown information, 2) Implementing the solution by determining the meaning of the symbols, using abstract symbols to identify the variables, and applying algebraic properties to reach the solution, as well as using functional thinking to identify relationships between variables, 3) Evaluating the solution by verifying the solution, simplifying the solution, and manipulating the symbols to ensure the solution's correctness, and 4) Expanding the solution by generalizing the general pattern of the simple interest formula.

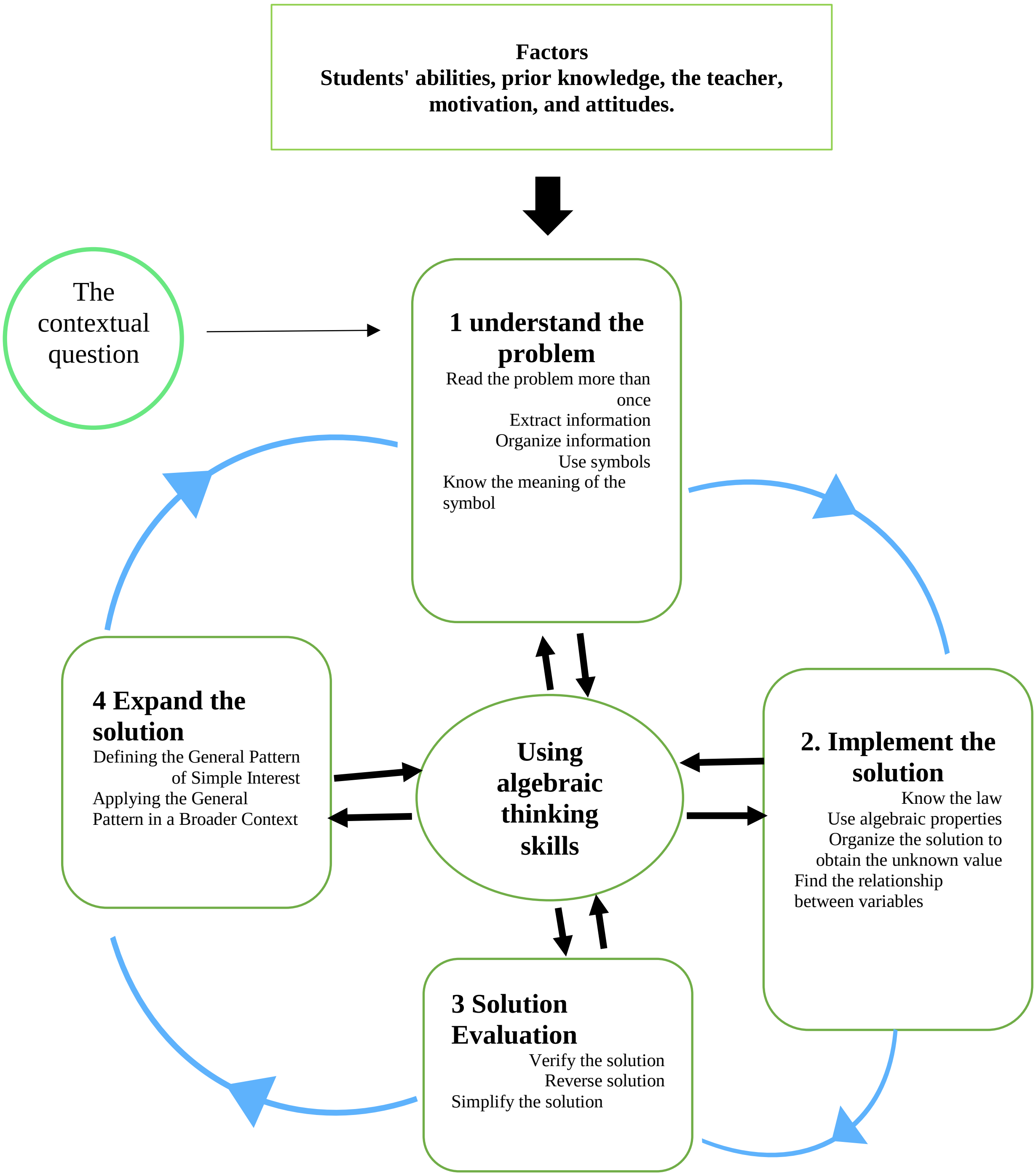



**Figure 3. The emerging final model for using algebraic thinking skills.**

The emerging model suggests that certain intervening factors, such as students' abilities, prior knowledge, the teacher, motivation, and attitude, can influence algebraic thinking skills in solving simple interest problems. Students' abilities affected their demonstration of algebraic thinking skills due to variations in student capabilities. High-ability students were able to engage in analytical thinking, abstraction, functional thinking, and generalization, which aligns with studies showing the impact of ability on algebraic thinking (Rahmawati et al.,2019). Additionally, some students faced challenges in using algebraic properties when solving the problem, which is linked to weak prior knowledge, consistent with Windsor & Norton's (2011) study, leading to weaker algebraic thinking. The learning style also impacted students' contributions, as some preferred using tables to simplify the solution process, which aligns with the study (Kobandaha et al.,2019). Students' attitudes were influenced by their ability to solve the simple interest problem, which is consistent with (Tak et al.,2025). It was noted that students with lower performance in algebra tend to have a lower preference for learning algebra, as negative attitudes can hinder students' success in mathematics (Zakaria& Yusoff,2009). Students also demonstrated the impact of the teacher when facing challenges during problem-solving. The study highlighted the importance of the teacher's role as a factor influencing algebraic learning, as it can either facilitate or hinder students' knowledge.

## 5. CONCLUSION AND RECOMMENDATIONS

This study explored how students in the Banking and Finance Diploma program at the Applied College of Umm Al-Qura University employ algebraic thinking skills when solving simple interest problems. Using a constructivist grounded theory approach, the research generated an emerging theoretical model that illustrates the cognitive processes through which students engage with algebraic reasoning in realistic financial contexts. The model revealed four interconnected processes—understanding the problem, executing the solution, evaluating the result, and extending the solution through generalization—that reflect how students navigate algebraic tasks.

The findings indicate that algebraic thinking is not applied in isolation or a linear fashion; instead, it unfolds dynamically within the context of solving authentic, profession-related problems. Contextual financial scenarios enhanced students' motivation, symbolic awareness, and ability to generalize patterns. Students demonstrated stronger functional reasoning when engaging with relevant and meaningful tasks, revealing the importance of context in fostering deeper mathematical understanding.

Additionally, the study identified several interacting factors that influence students' algebraic thinking skills, including prior mathematical knowledge, cognitive ability, instructional strategies, and affective variables such as motivation and attitudes toward mathematics. These findings align with prior literature (e.g., Rahmawati et al., 2019; Clarke & Roche, 2018), emphasizing real-world relevance, active learning, and student engagement in supporting algebraic reasoning.

In light of these insights, the study offers the following recommendations:

- **Curriculum Development**: Algebraic thinking skills—such as generalization, abstraction, and functional reasoning—should be explicitly integrated into applied mathematics courses, particularly in finance-related subjects. These skills should be contextualized within professional scenarios to improve relevance and student engagement.
- **Contextual Problem Design**: Learning tasks should simulate authentic workplace situations, including financial planning, investment analysis, and interest calculations, to support students' transition from symbolic manipulation to conceptual understanding.
- **Teacher Training**: Professional development programs should equip instructors with strategies to foster algebraic thinking through problem-based learning, exploratory approaches, and structured mathematical discussions that promote reflective thinking.
- **Flexible Assessment Tools**: Formative and diagnostic assessments should be designed to evaluate the four key processes identified in the model: understanding, execution, evaluation, and generalization. These tools can guide instructional adjustments and identify student needs.
- **Differentiated Instruction**: Instructional strategies should accommodate different learning styles and ability levels by offering multiple representations (e.g., symbolic, verbal, tabular) and diverse solution pathways.
- **Future Research**: Grounded Theory should be applied to other vocational fields (e.g., accounting, engineering, logistics) to build a broader understanding of algebraic thinking in authentic professional learning environments.

- **Enhancing Student Motivation**: Classroom environments should foster persistence, practical relevance, and a belief in algebra's usefulness. Linking mathematical thinking to students' career paths may improve attitudes and performance.

This study presents a contextually grounded and theoretically informed model for understanding how applied college students engage in algebraic thinking. The model offers practical implications for curriculum design, instructional methods, and future research on the intersection between mathematical thinking and vocational education.

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